WHAT IS CLAIMED IS

1. A waveguide grating router comprising a grating having an input curve and an output image curve, the input curve having N, N > 2, equally spaced waveguides connected thereto, the output curve having reflective elements placed thereon, the waveguide grating router characterized by

the grating having a plurality of elements forming multiple paths through the router so as to transform a particular input wavelength applied to one of the N waveguides into N components producing N interleaved sets of images wherein each set of images consists of different orders of the grating router and said each set is produced by one of the N components and

the output curve including N interleaved sets of reflective elements that have predefined phase shifts between the sets and are arranged so that all significant orders of each image set are reflected back through the router so as to efficiently transfer said particular input wavelength back to a selected one of the N waveguides, and wherein the selected waveguide is determined by preset phase shifts produced by the sets of reflective elements.

2. The waveguide grating router of claim 1 wherein

each of the reflective elements of the N interleaved sets has width essentially equal to Ω/N, where Ω is the spacing of the images in each set of images and

the spacing of the N waveguides is essentially equal to Ω/N divided by the magnification of the images.

3. The waveguide grating router of claim 1 wherein the N interleaved sets of reflective elements have element width essentially equal to Ω/N and they essentially produce a constant reflection over the width of each element.

4. The waveguide grating router of claim 1 wherein the grating includes a periodic path length component with period N so that the array elements are divided into a plurality of groups, each group consisiting of N consecutive elements and each of the N elements having a predetermined phase shift caused by the above path length component, so as to essentially split each input wavelength into N components, each illuminating one of the N sets of reflectors.

5. The waveguide grating router of claim 1 wherein

the two sets of reflective elements include means for adjusting the preset phase shifts.

6. The waveguide grating router of claim 5 wherein the means for adjusting the preset phase shifts includes thermooptic devices operable under control of a control signals.

7. The waveguide grating router of claim 1 wherein N equals 4.

8. The waveguide grating router of claim 1 arranged as a N/2 x N/2 switch having the N waveguides divided into two interleaved sets respectively composed of N/2 input waveguides and N/2 output waveguides and wherein the relative phase shifts of the N sets of reflective elements are controlled by control signals to switch an optical signal received by at least one of the N/2 input waveguides to any of the N/2 output waveguides.

9. The waveguide grating router of claim 1 wherein

at least one of the N interleaved sets of reflective elements is displaced from the output image curve.

10. The waveguide grating router of claim 1 wherein

at least one reflective element of at least one set of the N interleaved sets is realized using an array of waveguides combined with reflective terminations.

11. The waveguide grating router of claim 10 wherein

each waveguide is a multimoding waveguide.

12. The waveguide grating router of claim 10 wherein

all waveguide terminations are arranged along a straight surface.

13. The waveguide grating router of claim 1

wherein a comb of M input wavelengths, which are equally spaced within a free spectral range of the router, are all applied to one of the N waveguides and are transformed by the router into M N components producing M N interleaved sets of images, wherein each set of images consists of different orders of the grating router and said set is produced by one of the M N components,

the spacing of the N waveguides is equal to Ω/MN, where M an integer greater than one and Ω is the spacing of the images in each set of images, and

the output curve including MN interleaved sets of reflective elements that have predefined phase shifts between the sets, each of the reflective elements has a width equal to Ω/MN, and are arranged so that all significant orders of each image set are reflected back through the router so as to efficiently transfer anyone of said M input wavelengths back to a selected one of the N waveguides, and wherein the selected waveguide is determined by preset phase shifts produced by the sets of reflective elements illuminated by the particular input wavelength in question.

14. An imaging arrangement comprising a diffraction grating having an input curve and an output image curve, the input curve having N, N > 2, equally spaced waveguides connected thereto, the output curve having a plurality of spaced reflectors arranged thereon, the imaging arrangement characterized by

the diffraction grating consisiting of a plurality of elements forming multiple paths through the router so as to transform a particular input wavelength applied to one of the N waveguides into N components producing N interleaved sets of images wherein each set of images consists of different orders of the grating router and it is produced by one of the N components and

wherein the output curve includes N interleaved sets of reflective elements that have predefined phase shifts between the sets and are arranged so that all

significant orders of each image set are reflected back through the router so as to efficiently transfer said particular input wavelength back to a selected one of the N waveguides, and wherein the selected waveguide is determined by preset phase shifts produced by the sets of reflective elements.

15. The imaging arrangement of claim 14 wherein the diffration grating is an Echelle grating.

16. A waveguide grating router comprising

a first grating having an input curve and an output image curve, the input curve having N, N > 2, equally spaced input waveguides connected thereto, the output curve connected to N interleaved sets of arrays of coupling waveguides placed between said output curve and the input curve of a second waveguide grating;

the second grating having an output curve having N, N > 2, equally spaced output waveguides connected thereto;

the first and second grating both having a plurality of elements forming multiple paths through each router so as to transform a particular input wavelength applied to one of the N input waveguides of the first grating into N

components producing N interleaved sets of images coupled via the N interleaved sets of arrays of coupling waveguides to the input curve of the second grating and then to the output curve of the second grating; and

wherein each of the N sets of arrays of coupling waveguides has a predefined phase shifts, such that all significant orders of each image set are transmitted through the second router so as to efficiently transfer said particular input wavelength to a selected one of the N output waveguides, and wherein the selected waveguide is determined by preset phase shifts produced by the sets of arrays of coupling waveguides.

17. A method of operating a waveguide grating router comprising a grating having an input curve and an output image curve, the input curve having N, N > 2, equally spaced waveguides connected thereto, the output curve having a plurality of spaced reflectors arranged thereon, the method including the steps of

forming multiple paths through the router so as to transform a particular input wavelength applied to one of the N waveguides into N interleaved sets of equally spaced images on the output curve corresponding to different orders of the grating router;

reflecting back through the router, with predefined phase shifts from the N interleaved sets of reflective elements on the output curve, all significant orders of each image set so as to produce a single reflection of said particular input wavelength back to a selected one of the N waveguides, and

selecting one of the N waveguides using preset phase shifts produced by the of reflective elements.